A masonry gravity weir structure extends upstream from the dam on the right abutment to serve as the intake to the Coleman Canal. The weir structure has a crest width of 4 feet and a crest length of 44 feet, with an approximate crest elevation of 1002.3 feet (1 foot below the dam crest). The weir structure rises about 12 feet above the original streambed surface, with a near vertical downstream face and an upstream slope of about 0.33H:1.0V. A masonry gravity retaining wall extends approximately 200 feet downstream from the dam along the Coleman Canal, with a top width of 2 feet, a near vertical downstream face, and an upstream slope of 0.33H:1.0V from the foundation to about 3.5 feet below the top of the wall, where the face becomes vertical.

Diversions to the Coleman Canal are controlled by a series of gate structures located downstream of the dam. The Coleman Canal extends nearly 10 miles to the Coleman Forebay and Powerhouse, and consists of 389 feet of rock tunnel sections 11-feet-wide by 9-feet-high; 83 feet of concrete bench flume, replacing a metal flume section; 46,240 feet of excavated channel sections (30,912 feet unlined and 15,328 feet lined) with a bottom width of 15 feet, a top width of 20 feet, and a flow depth of 9 feet; and 4,518 feet of 90-inch-diameter siphon pipe.

The dam is not under the jurisdiction of the DWR Division of Safety of Dams, due to its small size (less than 25 feet in height, and less than 50 acre-feet of storage). FERC has classified the Coleman Diversion Dam as a low hazard structure. The diversion dam was inspected by FERC in July 1997, and was found to be in good condition, without signs of significant deterioration or structural distress [5]. The facility was visited by Reclamation personnel on June 26, 1998, at which time about 300 ft^3/s was being released over the dam crest and about 300 ft^3/s was being diverted to the canal over the upstream weir, which prevented a close inspection of the structures.

D. Streamflow Diversion Requirements and Construction Sequence

Total streamflow on Battle Creek has been recorded at the Coleman National Fish Hatchery near Cottonwood, California (USGS gauging station No. 11376550) since October 1, 1961. A graphical plot of average daily discharge values from 1961 to 1996 for the 357 mi^2 total drainage area is shown on figure 1. Peak flows recorded on Battle Creek since 1961 have occurred during the months of October through May. Minimum total streamflow is shown to be approximately 250 ft^3/s for the 35 years of record.

Reliable, detailed streamflow data do not currently exist for either North Fork Battle Creek or South Fork Battle Creek. Streamflow gauges currently located on both creeks are used by PG&E to ensure that minimum streamflow requirements are met, and generally do not record higher flows. DWR estimated historic, average daily flows at Eagle Canyon Diversion Dam, having a drainage area of 186 mi^2, by multiplying the recorded average daily flows at the Battle Creek stream gauge by the ratio of the drainage areas (186/357, or 52 percent). This was considered reasonable for higher flows, but was not believed to be accurate for lower flows [2]. The same approach was used by Resource Management International (RMI) to determine median monthly flows for each of the three damsites. Two permanent streamflow gauging stations have been proposed for installation downstream of the Coleman and Wildcat Diversion Dams to provide more reliable data for future studies.

A square root relationship has been found by Reclamation to be generally more accurate for estimating instantaneous peaks and for short duration volume frequency values (less than 60 days) of ungauged areas [6]. This relationship assumes the ratio of streamflows at two different locations is equal to the ratio of the square root of the drainage areas, rather than the simple ratio of the areas. The square root relationship results in 38 percent higher estimates of streamflow at the Wildcat and Eagle Canyon damsites, and 86 percent higher estimates of streamflow at the Coleman damsite. Median monthly streamflow data recorded at the Coleman National Fish Hatchery for three "normal" water years (1985, 1989, and 1993) are averaged and apportioned for each of the damsites, using the square root relationship, in table 2 below. These estimates can be used as an upper bound for determining streamflow diversion requirements under normal conditions. The Battle Creek Working Group has selected 1989 as a typical water year for analysis and modeling purposes [3].

Table 2. - Streamflow Estimates Using Square Root Relationship (Normal Years) - in ft^3/s

Calendar Months	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1985 Streamflow	357	521	471	391	376	401	517	416	342	266	254	270
1989 Streamflow	205	259	265	341	298	1060	776	479	381	270	229	245
1993 Streamflow	134	204	237	701	640	732	751	785	696	384	291	229
Average of 3 years	232	328	324	478	438	731	681	560	473	307	258	248
At Wildcat Dam	169	239	236	348	319	532	496	407	344	223	188	180
At Eagle Canyon Dam	167	237	234	345	316	528	492	404	341	222	186	179
At Coleman Dam	124	175	173	256	234	391	364	299	253	164	138	133

The determination of streamflow diversion requirements for dam removals on both the North Fork and South Fork will be based on a combination of the natural streamflow in each drainage area, and on the available diversion capacity upstream of each dam (see Battle Creek Project Schematic, Appendix A-3, and the 1980 Historic American Engineering Record, reference [7]). In order to minimize the streamflow diversion requirements at each damsite during removal activities, thereby minimizing removal costs, a proposed construction sequence and operating plan for removal of all three dams has been developed for this reconnaissance study as follows:

1. **Schedule dam removals during historical low flow period** for Battle Creek, in July through October, to facilitate construction activities. This will also serve to minimize power generation impacts [2] and potential impacts on spring-run and winter-run salmon.

2. **Remove Wildcat Diversion Dam first**, with full diversions from North Fork Battle Creek to South Fork Battle Creek of up to 180 ft^3/s via the existing Cross-

Country Canal, with a capacity of 110 ft^3/s (fed by diversions from the Al Smith, Keswick, and North Battle Creek Feeder Canals), and the existing Eagle Canyon Canal, with a capacity of 70 ft^3/s. The upstream North Battle Creek Reservoir, with a total storage capacity of 1,012 acre-feet, and Macumber Reservoir, with a total storage capacity of 860 acre-feet, are kept full through the summer recreation season in accordance with the FERC operating license, and would not be available to provide short-term streamflow reduction. Assume a streamflow diversion requirement of 30 ft^3/s for removal of Wildcat Diversion Dam, based on the minimum flow requirement below Eagle Canyon Dam. This assumption is reasonable for normal streamflow conditions in July through October.

3. **Next, remove Eagle Canyon Diversion Dam**, with full diversions from North Fork Battle Creek to South Fork Battle Creek of up to 110 ft^3/s via the Cross-Country Canal. Some additional diversion capacity may be available using the Eagle Canyon Canal and the existing canal wasteway downstream of the dam, to further reduce the streamflow. Assume a streamflow diversion requirement of 70 ft^3/s for removal of Eagle Canyon Diversion Dam, based on anticipated flow conditions without diversions to the canal. This assumption is reasonable for normal streamflow conditions in August through October.

4. **Complete the direct pipe connection between the Inskip Powerhouse tailrace and the Coleman Canal.** This would require no diversions from North Fork Battle Creek to the Eagle Canyon Canal, and minimum diversions from South Fork Battle Creek to both the Inskip Canal and the Coleman Canal (through a temporary bypass pipe), during final construction. This work would be scheduled to minimize potential impacts on all required work activities, and would be concurrent to some degree with the removal of Wildcat and Eagle Canyon Diversion Dams. DWR is preparing reconnaissance-level designs and cost estimates for this feature. (A construction schedule for this work is needed to fully assess the potential impacts.)

5. **Remove Coleman Diversion Dam last**, with no diversions from North Fork Battle Creek, and with full diversions from South Fork Battle Creek to the Inskip Canal of up to 200 ft^3/s through the Inskip Powerhouse to the Coleman Canal through the completed direct pipe connection. If necessary (although unlikely), make additional diversions from South Fork Battle Creek into the Coleman Canal at the Inskip Powerhouse tailrace, via the direct pipe connection, requiring the installation of a temporary fish screen at the pipe inlet. Assume a streamflow diversion requirement of 30 ft^3/s for removal of Coleman Diversion Dam, based on the minimum downstream flow requirement. This assumption is reasonable for normal streamflow conditions in July through December.

Note that under normal streamflow conditions, the entire flow of South Fork Battle Creek could be diverted to the Inskip Canal at Inskip Diversion Dam, with a minimum of 30 ft^3/s returning to the stream through the existing Coleman Canal wasteway downstream of Coleman Diversion Dam, allowing a complete unwatering of the Coleman damsite. Although this is not assumed for the current reconnaissance-level estimate, a determination should be made whether unwatering South Fork Battle Creek between Inskip and Coleman Diversion Dams is environmentally feasible. At a minimum, a greatly reduced streamflow may be found to be acceptable, such as the original FERC requirement of 5 ft^3/s, to minimize the dam removal cost.